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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Well drilling bit assembly

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WELL DRILLING BIT ASSEMBLY

The present invention relates to a well-drilling bit assembly suitable for through-bit operation.

International patent application with publication No. WO 00/17488 discloses a system for drilling and logging of a wellbore formed in an earth formation, wherein a logging tool can be lowered in the wellbore from inside a drill string through a well drilling bit at the lower end of the drill string.

The known system comprises a well-drilling bit including a bit body provided with a passageway for the logging tool, and a closure element for the passageway in the form of an insert section at the bit face. The bit body is attachable to a tubular drill string at a drill-string side of the bit body, and the passageway extends from an opening at the drill-string side to the well exterior of the bit body. The closure element comprises a bit-connecting means in the form of a primary latching device for selectively connecting the closure element to the bit body, so as to selectively close the passageway.

The known system further comprises an auxiliary tool for manipulating the closure element, which auxiliary tool forms the downstream part of a logging tool string.

In the specification and in the claims the terms downstream and upstream are used in relation to the lowering of a tool into a borehole, so that upstream is closer to the surface than downstream.

The logging tool string of the known system is arranged so that it can pass from the attached drill

string through the opening of the bit body at the drill-string side, along the passageway so that it can reach the closure element, when the closure element is connected to the bit body. The auxiliary tool comprises a tool-connecting means in the form of a secondary latching device for selectively connecting the auxiliary tool to the closure element. The secondary latching device is further so arranged that simultaneously with the latching of the auxiliary tool to the closure element, the primary latching mechanism is operated so that the closure element is unlatched from the bit body while remaining attached to the auxiliary tool.

The well drilling bit of the known system can be used for drilling operation, when the closure element is connected to the bit body. When it is desired to log the formation, drilling operation is stopped, and the logging tool string with the auxiliary tool at its lower end is lowered through the drill string into the passageway. The tool-connecting means (secondary latching mechanism) is connected to the closure element, and, simultaneously, the bit-connecting means (primary latching mechanism) is operated so as to release the closure element from the bit body. Then, the logging tool can be lowered into the wellbore ahead of the well drilling bit from where logging can be performed. After logging has been completed, the logging tool string can be pulled back into the drill string, so that the closure element is re-connected to the bit body and the auxiliary tool is simultaneously disconnected from the closure element.

The known system has the disadvantage of limited robustness. Fail-safe operation of downhole equipment is generally very important in well drilling operations. With the known system there is for example a risk that

the closure element is not sufficiently connected to the bit body in a situation wherein the auxiliary tool is not fully connected to the closure element. This can happen during removal of the closure element, and also when it is attempted to re-insert the closure element after logging was completed. Consequently, the closure element could be lost in the wellbore.

It is therefore an object of the present invention to provide a well-drilling bit assembly suitable for through-bit operation, which allows robust and fail-safe operation of the connections between the closure element and the bit body and between the closure element and the auxiliary tool.

To this end in accordance with the present invention there is provided a well-drilling bit assembly suitable for through-bit operation, comprising a well-drilling bit, which includes

- a bit body attachable to a tubular drill string at a drill-string side of the bit body, which bit body is internally provided with a passageway between an opening at the drill-string side and the exterior of the bit body;
- a closure element for the passageway; and
- a bit-connecting means for releasably connecting the closure element to the bit body so as to selectively close the passageway;

the well-drilling bit assembly further comprising an auxiliary tool for manipulating the closure element, which auxiliary tool is arranged so that it can pass along the passageway to the closure element, when the closure element is connected to the bit body, wherein the auxiliary tool comprises a tool-connecting means for selectively connecting the auxiliary tool to the closure

element, and an operating means for operating the bit-connecting means,

wherein the auxiliary tool comprises a first member which includes the tool-connecting means and a second member which includes the operating means, which second member is arranged movably so that it can assume a first and a second position relative to the first member, wherein in the first position the tool-connecting means is connectable, at least when the closure element is connected to the bit body, to the closure element without operating the bit-connecting means, and wherein after connecting the auxiliary tool to the closure element the bit-connecting means can be operated by moving the second member including the operating means between the first and the second position.

The present invention starts from the insight that the auxiliary tool has to perform two functions, on the one hand the connection of the closure element to the auxiliary tool, and on the other hand the operation of the bit-connection means which connects the closure element to the bit body. It was further realized that the robustness of the manipulation of the closure element using the auxiliary tool can be increased, if the two functions of the auxiliary tool are decoupled from each other in a specific way, so that the bit-connecting means can only be operated when the auxiliary tool is connected to the closure element. In this way it is prevented that the closure element can be lost in the wellbore, since it can only be disconnected from the well drilling bit if it is fully connected to the auxiliary tool.

The invention achieves the decoupling of functions in that the auxiliary tool comprises first and second members, each of which is associated with mainly one of

the functions, and which are movable relative to each other. In a first relative position between first and second members the auxiliary tool can be connected to the closure element, and by moving the first and second members into their second relative position, the bit-connecting means is operated.

In an advantageous embodiment of the well-drilling bit assembly, the tool-connecting means is arranged near the downstream end of the first member, the operating means is arranged near the downstream end of the second member, and the second member is arranged longitudinally slideably along the passageway with respect to the first member. Suitably then in the first relative position the second member is an upstream position with respect to the first member, and the second member is moved in downstream direction when moving it towards the second relative position.

This embodiment is advantageous because it allows simple operation of the bit-connecting means by longitudinal motions alone. By lowering the auxiliary tool with the second member in the first relative position, the auxiliary tool can connect to the closure element. With a further longitudinal motion of the second member with respect to the first member, the bit connecting means can be operated. Such a longitudinal motion can easily be induced.

Suitably the passageway upstream of the closure element and/or the auxiliary tool are provided with an orienting device for angularly orienting the auxiliary tool, so that a fail safe operation can be further ensured by bringing auxiliary tool and closure element in a predetermined angular orientation with respect to each other at the moment of connecting (on order to open the

passageway) and/or at the moment of disconnecting (when closing the passageway again). Suitably, to this end, the auxiliary tool at its outer wall is provided with an outwardly projecting key, and the inner wall of the passageway is provided with two guiding rims forming a central guiding groove through which the key can pass, the guiding groove having upstream and downstream ends, further with an upstream camming rim extending from a position upstream of the guiding groove to the upstream end of the guiding groove fully around the inner wall, and with a downstream camming rim extending from a position downstream of the guiding groove to the downstream end of the guiding groove fully around the inner wall, wherein the camming rims and the guiding rims project sufficiently into the passageway so as to engage, when the auxiliary tool is moved through the passageway, the key and to guide the key into the guiding groove, thereby angularly orienting the auxiliary tool. Alternatively, the camming rims and guiding groove van also be provided on the circumference of the auxiliary tool, and a key on the inner surface of the passageway.

The tool-connecting means of the auxiliary tool and the co-operating part of the closure element are further suitably shaped such that only in the correct predetermined relative angular position between them, as determined by the orienting device, connecting/disconnecting of the auxiliary tool to/from the closure element, and further operation of the bit connecting means is possible.

Other advantages of the invention will be discussed with reference to the Figures, wherein

Figure 1 shows schematically a well drilling bit for use with the present invention;

Figure 2 shows schematically the upstream part of an auxiliary tool according to the invention;

Figure 3 shows schematically the downstream part of an auxiliary tool according to the invention;

Figure 4 shows schematically a cross-section taken at IV-IV in Figure 3;

Figure 5 shows schematically the interaction between auxiliary tool and well drilling bit in a first situation;

Figure 6 shows schematically the interaction between auxiliary tool and well drilling bit in a second situation; and

Figure 7 shows schematically the interaction between auxiliary tool and well drilling bit in a third situation.

Reference is made to Figure 1, showing a longitudinal cross-section of a well drilling bit 1 for through-bit operation, which bit is suitable for use with the present invention. The well drilling bit 1 is shown in the borehole 2, and is attached to the lower end of a drill string 3. The well drilling bit 1 comprises a bit body 6 including a bit shank 7 which together form a central longitudinal passageway 8 for a tool, between the interior 3a of the drill string 3 and the borehole 2 exterior of the well drilling bit 1, as will be pointed out in more detail below. Bit nozzles are arranged in the bit body 6. Only one nozzle 9 is shown for the sake of clarity. The nozzle 9 is connected to the passageway 8 via the nozzle channel 9a.

The well drilling bit 1 is further provided with a removable closure element 10, which is shown in Figure 1 in its closing position with respect to the passageway 8. The closure element 10 of this example includes a central

insert section 12 and a latching section 14. The insert section 12 is provided with cutting elements 16 at its front end, wherein the cutting elements are arranged so as to form, in the closing position, a joint bit face together with the cutters 18 at the front end of the bit body 6. The cutting elements 16 and 18 can be polycrystalline diamond cutters. The insert section is also provided with nozzles 19. Further, the insert section and the cooperating surface of the bit body 6 are shaped suitably so as to allow transmission of drilling torque from the drill string 3 and bit body 6 to the insert section 12.

The latching section 14, which is fixedly attached to the rear end of the insert section 12, has substantially cylindrical shape and extends into a central longitudinal bore 20 in the bit body 6 with narrow clearance. The bore 20 forms part of the passageway 8, it also provides fluid communication to nozzles in the insert section 12.

Via the latching section 14 the closure element 10 is removably attached to the bit body 6. The latching section 14 of the closure element 10 comprises a substantially cylindrical outer sleeve 23 which extends with narrow clearance along the bore 20. A sealing ring 24 is arranged in a groove around the circumference of the outer sleeve 23, to prevent fluid communication along the outer surface of the latching section 14. Connected to the lower end of the sleeve 23 is the insert section 12. The latching section 14 further comprises an inner sleeve 25, which slidingly fits into the outer sleeve 23. The inner sleeve 25 is provided with an annular rim 26, which is biased in upstream direction against an inward shoulder 28 of the outer sleeve 23. The biasing force is exerted by a partly compressed helical

spring 30, which pushes the inner sleeve 25 away from the insert section 12. At its lower end the inner sleeve 25 is provided with an annular recess 32 which is arranged to embrace the upper part of spring 30.

The outer sleeve 23 is provided with recesses 34 wherein locking balls 35 are arranged. A locking ball 35 has a larger diameter than the thickness of the wall of the sleeve 23, and each recess 34 is arranged to hold the respective ball 35 loosely so that it can move a limited distance radially in and out of the sleeve 23. Two locking balls 35 are shown in the drawing, however it will be clear that more locking balls can be arranged. As an alternative for locking balls, locking dogs can be used.

In the closing position as shown in Figure 1 the locking balls 35 are pushed radially outwardly by the inner sleeve 25, and register with the annular recess 36 arranged in the bit body 6 around the bore 20. In this way the closure element 10 is locked to the well drilling bit 1, and the locking balls 35 together with the groove 36 form part of a bit-connecting means for connecting the closure element 10 to the bit body 6.

The inner sleeve 25 is further provided with an annular recess 37, which is, in the closing position, longitudinally displaced with respect to the recess 36 in the direction of the drill string 3, i.e. in upstream direction. There can also be provided inner recesses 38. As will be explained in more detail below, the bit-connecting means can be operated by inducing a longitudinal motion of the inner sleeve 25 with respect to the outer sleeve 23, because in this way the locking balls 36 can be locked into and released from the groove 36.

The upstream end 23a of the outer sleeve 23 is funnel-shaped so as to guide an auxiliary tool into the latching section 14, which auxiliary tools serves to connect to the closure element and to operate the bit-connecting means. Latching recesses 39 are arranged in the outer sleeve 23, and co-operate with a tool-connecting means of the auxiliary tool.

The latching section 14 further comprises a two-way orienting device 40 and a spring-biased activation button 45, which are both arranged to co-operate with an auxiliary tool which can be deployed through the interior of the drill string for manipulating the closure element 10. The orienting device 40 comprises a guiding groove 41 formed by inwardly extending rims 42a, 42b, which extend in upstream and downstream direction fully around the circumference of the passage 8, to form an upstream camming rim 43 and a downstream camming rim 44. The orienting device 40 is drawn as shown in Figure 1 for the sake of clarity, suitably however it is oriented such that the guiding groove 41 is arranged opposite the button 45.

An embodiment of the auxiliary tool will now be discussed.

Reference is made to Figures 2-4. Figure 2 shows schematically the upstream part of an auxiliary tool, and Figure 3 the downstream part of an auxiliary tool according to the invention in longitudinal cross-section. Figure 4 shows a cross-section taken at IV-IV in Figure 3.

The auxiliary tool 50 for manipulating the closure element 10 is arranged so that it can pass from surface through the interior of the drill string 3, along the passageway to the closure element 10, when the closure

element is connected to the bit body 6 as shown in Figure 1. To this end the auxiliary tool is elongated and substantially cylindrical having a maximum outer diameter of less than the inner diameter of the drill string 3. The most downstream part of the auxiliary tool which has to pass into and possibly through the drill bit has a maximum outer diameter of less than the minimum diameter of the passageway. A typical minimum diameter of the passageway is 6 cm (2.5 inch), when the drilling bit 1 has a diameter of as low as 15 cm (6 inch), or 21 cm (8.5 inch), or 31 cm (12.25 inch).

The auxiliary tool comprises a first, outer member 55 and a second member in the form of inner piston 56. The outer member 55 of this example has a housing formed by parts 57,58,59, which are assembled by screws 60,61. The outer member 55 includes a tool-connecting means at its most downstream end. The tool-connecting means includes four latching petals 63, which are arranged to co-operate with the latching recesses 39 in the latching section 14 of the closure element 10, so as to selectively and releasably connect the auxiliary tool to the closure element.

The inner piston 56 is provided with an operating means at its downstream end, in the form of a plunger 64. The plunger 64 has a cross-shaped cross-section at its most downstream end, as is best visible in Figure 4, and serves to longitudinally shift the inner sleeve 25 with respect to the outer sleeve 23 of the latching section. To this end the inner piston 56 is longitudinally movable with respect to the outer member 55. The plunger 64 is shown at 66 in a first, retracted position. This position at the same time characterizes the relative position between the first, outer member 56 and the inner piston

(second member) 56. This is also visible from the upstream part of the auxiliary tool 50 in Figure 2, wherein the shaft 67 that is connected to the upper part of the inner piston 56 is fully retracted from the upper part of the outer member 55. The shaft 67 has a shoulder 68, and is connected via a swivel 69 to other equipment (not shown) such as tubing or a logging tool. The swivel allows rotation of such other equipment with respect to the auxiliary tool.

With the plunger in this retracted position, the latching petals 63 of the outer member 55 have transverse flexibility towards the axis 70 of the auxiliary tool, so that they can enter into the latching section 14 and connect into the latching recesses 39. The inner piston 56 can also be longitudinally moved to assume other positions relative to the outer member 55. One such position is indicated dashed at 71, and in this position the petals 63 cannot flex anymore towards the axis.

The plunger 64 is arranged so that it can push onto the upper end of the inner sleeve, thereby forming an operating means for the bit-connecting means as discussed before.

This will be discussed in more detail with respect to Figures 5-7.

The auxiliary tool is further provided with several parts that even further support fail-safe operation: Upstream trigger 72 forming a first retaining device and downstream trigger 73 forming a second retaining device are arranged on the outer member 55 to co-operate with a recess 75 on the inner piston 56 and with the button 45 of the bit body 6, as will be explained in more detail below. The triggers 72 and 73 are provided with notches 77, 78 extending through an opening 80 in the

housing 58, and are pivotably mounted about axes 82,83, wherein the ends opposite the notches are biased in the direction of the inner piston 56 by means of a spring 86,87.

The housing is further provided with a key 90 projecting out of the substantially cylindrical outer surface of the downstream part of the outer member 55, co-operating with the two-way orienting tool 40 of the bit body 6. The key 90 is elongated, parallel to the direction of the axis 70, and has tapered edges giving it a boat-like shape. The key is supported by springs 92. Downstream of the key 90 and slightly angularly displaced there is an anti-collision button in the form of a radially outwardly extending tip 95 supported by a spring 97.

The inner piston 56 can further be provided with fingers (not shown for the sake of clarity) extending more downstream than the plunger 64, which fingers can co-operate with recesses 38 in the closure element 10. In this way, also the inner piston can be connected to the insert section in a predetermined position, which can further contribute to fail-safe operation in the event of strong longitudinally outward forces on the insert section 12 due to pulling or pumping.

The function of the parts to ensure fail-safe operation will become clear from the discussion of Figures 5-7.

Reference is made to Figure 5-7 showing several stages of the interaction between the auxiliary tool and the well drilling bit. Reference numerals correspond to those already used in connection with Figures 1-4.

The well drilling bit 1 with the closure element 10 in the closing position as shown in Figure 1 can be used for progressing the wellbore 2.

The well drilling bit 1 with the closure element 10 in the closing position as shown in Figure 1 has the shape and full functionality of a conventional PDC well drilling bit and can thus be used for normal drilling operation in the same way as well known in the art, e.g. by rotating the drill string 3 and putting weight on the bit.

When it is desired to open the passageway 8 by removing the closure element 10 from its closing position, the well drilling bit is first positioned a distance above the bottom of the borehole. Then, the closure element 10 can be outwardly removed from the closing position in the well drilling bit 1.

To this end, the auxiliary tool 50 is lowered from surface or from a position inside the drill string 3 along the passageway 8 from the drill string through the opening of the drill string side of the bit body into the bit body 6.

When lowering the auxiliary tool 50, the inner piston 56 is in its retracted position 66, which is also referred to the first position relative to the outer member 56 in the specification and in the claims. When the lower part of the auxiliary tool enters the bit body 6, the key 90 engages the upstream camming rim 43 (not shown in Figures 5-7 for the sake of clarity) and the auxiliary tool is turned about the swivel 69 so that a predetermined angular position between the tool-connecting means and the latching section 14 is achieved the point where the auxiliary tool contacts the latching section 14.

The petals 63, forming the tool-connecting means on the downstream end of the outer member 56, are received and guided by the funnel-shaped upstream end 23a of the outer sleeve 23 into the latching section 14. The legs of the petals 63 are inwardly deformed until the petals 63 register with the recesses 39 so that they can snap outwardly. This position, wherein the auxiliary tool 50 is connected to the closure element 10 is shown in Figure 5.

It is also clear from the drawing that the button 45 has engaged the notch 77 of the upstream trigger 72 (which forms a first retainer device), thereby lifting the upstream end of the trigger 72 out of the recess 75. Therefore, when the petals 63 have connected into the recesses 39, the first retainer device 72 is operated (released) so that it does not block anymore downstream motion of the inner piston 56.

Further pushing on the upstream end of the auxiliary tool 50 will cause the inner piston 56 to slide longitudinally relative to the outer member 55. The plunger 64 engages the upstream end of the inner sleeve 25, which has a smaller inner diameter than the diameter of the plunger 64. Further downstream motion of the inner piston causes the inner sleeve to be pushed against the force of the spring 30, until the locking balls 35 register with the recesses 37. This situation is shown in Figure 6. The locking balls are therefore allowed to move inwardly, thereby unlocking the closure element from annular recess 36, i.e. from the bit body. In this way the plunger 64 forms an operating means for the bit-connecting means. The relative position between the inner piston 56 and the outer member 55 at which the locking balls are fully released from the annular

recess 36 is referred to as the second relative position in the specification and in the claims.

In the position shown in Figure 6, the inner piston 56 prevents inward flexing of the petals 63, so that the auxiliary tool 50 is securely locked to the closure element 10. Also, in this position the recess 75 on the inner piston has moved so far that it registers with the downstream trigger 73 (second retainer device). The downstream end of the downstream trigger 73 is forced into the recess 75 by the action of the spring 87, and blocks the longitudinal upstream motion of the inner piston 56 with respect to the outer member 56 when the closure element 10 is unlatched.

By further pushing on the auxiliary tool 50 in downstream direction the closure element 10 is outwardly removed from the bit body 6. This is shown in Figure 7. Suitably the auxiliary tool can be hung off in the bottom hole assembly, so that it can easily be retrieved. The auxiliary tool can for example be mounted on the lower end of a logging tool, so that the logging tool can in this way be passed into the open borehole ahead of the bit body 6, where logging measurements can be performed. If instead of a logging tool a fluid injection tool is used, fluid injection operations can be performed in the borehole, e.g. cementing, injection of lost circulation material, or jet cleaning of the borehole wall or of the bit cutters.

The well drilling bit 1 and auxiliary tool 50 are such designed that the closure element 10 can be re-latched to the bit body 6 if that is desired.

When starting from the situation depicted in Figure 7, when the auxiliary tool is pulled in upstream direction, the downstream trigger 73 interacting with the

recess 75 keeps the inner piston in the position relative to the outer member 55 as shown.

The key 90 interacts with the downstream camming rim 44 (which is only shown in Figure 1 for the sake of clarity) so as to bring the closure element 10 with attached auxiliary tool 50 into a predetermined angular orientation with respect to the bit body 6.

When the position shown in Figure 6 is reached, the locking balls 35 are about to be forced back into the annular recess 36. At this position, the button 45 activates the downstream trigger 73 so that it is released from the recess 75, and the inner piston 56 including the plunger 64 at its downstream end can be moved in upstream direction. The inner sleeve 25 including the recesses 37 shifts upwardly, and the locking balls are locked again into the annular recess 36.

The inner piston is moved to the position relative to the outer member as shown in Figure 5, and no longer blocks inward flexing motion of the petals 63. Therefore, by further pulling the auxiliary tool up, e.g. from surface, the petals 93 disengage from the recesses 39, and to this end the upstream edges are slightly bevelled as shown in the drawing. After pulling slightly further, the button 45 disengages from the upstream trigger 72 which will subsequently prevent the inner piston from moving in downstream direction again.

As shall be clear from the foregoing discussion, the present invention allows fail-safe removal of the closure element of a well drilling bit, by simply passing/pushing the auxiliary tool down the drill string (e.g. by using tubing extending to surface or pumping). The invention in particular prevents that the closure element can be lost

in the well bore. Also, fail-safe re-connecting is possible by simply passing/pulling the auxiliary tool up again (e.g. by tubing or wireline).

C L A I M S

1. A well-drilling bit assembly suitable for through-bit operation, comprising a well-drilling bit, which includes

- a bit body attachable to a tubular drill string at a drill-string side of the bit body, which bit body is internally provided with a passageway between an opening at the drill-string side and the exterior of the bit body;
- a closure element for the passageway; and
- a bit-connecting means for releasably connecting the closure element to the bit body so as to selectively close the passageway;

the well-drilling bit assembly further comprising an auxiliary tool for manipulating the closure element, which auxiliary tool is arranged so that it can pass along the passageway to the closure element, when the closure element is connected to the bit body, wherein the auxiliary tool comprises a tool-connecting means for selectively connecting the auxiliary tool to the closure element, and an operating means for operating the bit-connecting means,

wherein the auxiliary tool comprises a first member which includes the tool-connecting means and a second member which includes the operating means, which second member is arranged movably so that it can assume a first and a second position relative to the first member, wherein in the first position the tool-connecting means is connectable, at least when the closure element is connected to the bit body, to the closure element without operating the bit-connecting means, and wherein after

connecting the auxiliary tool to the closure element the bit-connecting means can be operated by moving the second member including the operating means between the first and the second position.

2. A well-drilling bit according to claim 1, wherein the tool-connecting means is arranged near the downstream end of the first member, wherein the operating means is arranged near the downstream end of the second member, and wherein the second member is arranged longitudinally slideably along the passageway with respect to the first member, so that the first relative position is an upstream position of the second member, and wherein the second member is moved relative to the first member in downstream direction when moving it towards the second relative position.

3. A well-drilling bit according to claim 2, wherein the first member of the auxiliary tool comprises a substantially tubular body in which the second member is coaxially slideably arranged, wherein the closure element comprises at its upstream end an outer sleeve and a coaxial inner sleeve, wherein the upstream end of the outer sleeve is arranged to cooperate with the tool-connecting means so as to lock the auxiliary tool to the outer sleeve, wherein the upstream end of the inner sleeve is arranged to cooperate with the operating means of the auxiliary tool so that the bit-connecting means is operated by longitudinally sliding the inner sleeve with respect to the outer sleeve.

4. A well-drilling bit according to any one of the previous claims, wherein the bit further comprises an operable first retainer device for securing the second member of the auxiliary tool in the first relative

position when the auxiliary tool is not connected to the closure element.

5. A well-drilling bit according to claim 4, wherein the bit body is provided with a button which projects into the passageway and co-operates with the first retainer device so as to operate the first retainer device at a predetermined relative position between the button and the first retainer device.

6. A well-drilling bit according to any one of the previous claims, further comprising a selectively operable second retainer device for securing the second member of the auxiliary tool in the second relative position when the auxiliary tool is connected to the closure element while the closure element is not connected to the bit body.

7. A well-drilling bit according to claim 6, wherein the bit body is provided with a button which projects into the passageway and co-operates with the second retainer device so as to operate the second retainer device at a predetermined relative position between the button and the second retainer device.

8. A well-drilling bit according to any one of claims 1-7, wherein the passageway and the auxiliary tool are provided with co-operating angular orienting means.

A B S T R A C T

WELL DRILLING BIT ASSEMBLY

A well-drilling bit assembly suitable for through-bit operation, comprising a well-drilling bit, which includes

- a bit body which bit body is internally provided with a passageway;
- a closure element for the passageway; and
- a bit-connecting means for releasably connecting the closure element to the bit body;

the well-drilling bit assembly further comprising an auxiliary tool for manipulating the closure element, wherein the auxiliary tool comprises a first member which includes a tool-connecting means and a second member which includes and operating means for the bit-connecting means, which second member is arranged movably relative to the first member, so that the tool-connecting means is connectable to the closure element without operating the bit-connecting means, and wherein after connecting the auxiliary tool to the closure element the bit-connecting means can be operated by moving the second member relative to the first member.

(Figure 6)

Fig. 1

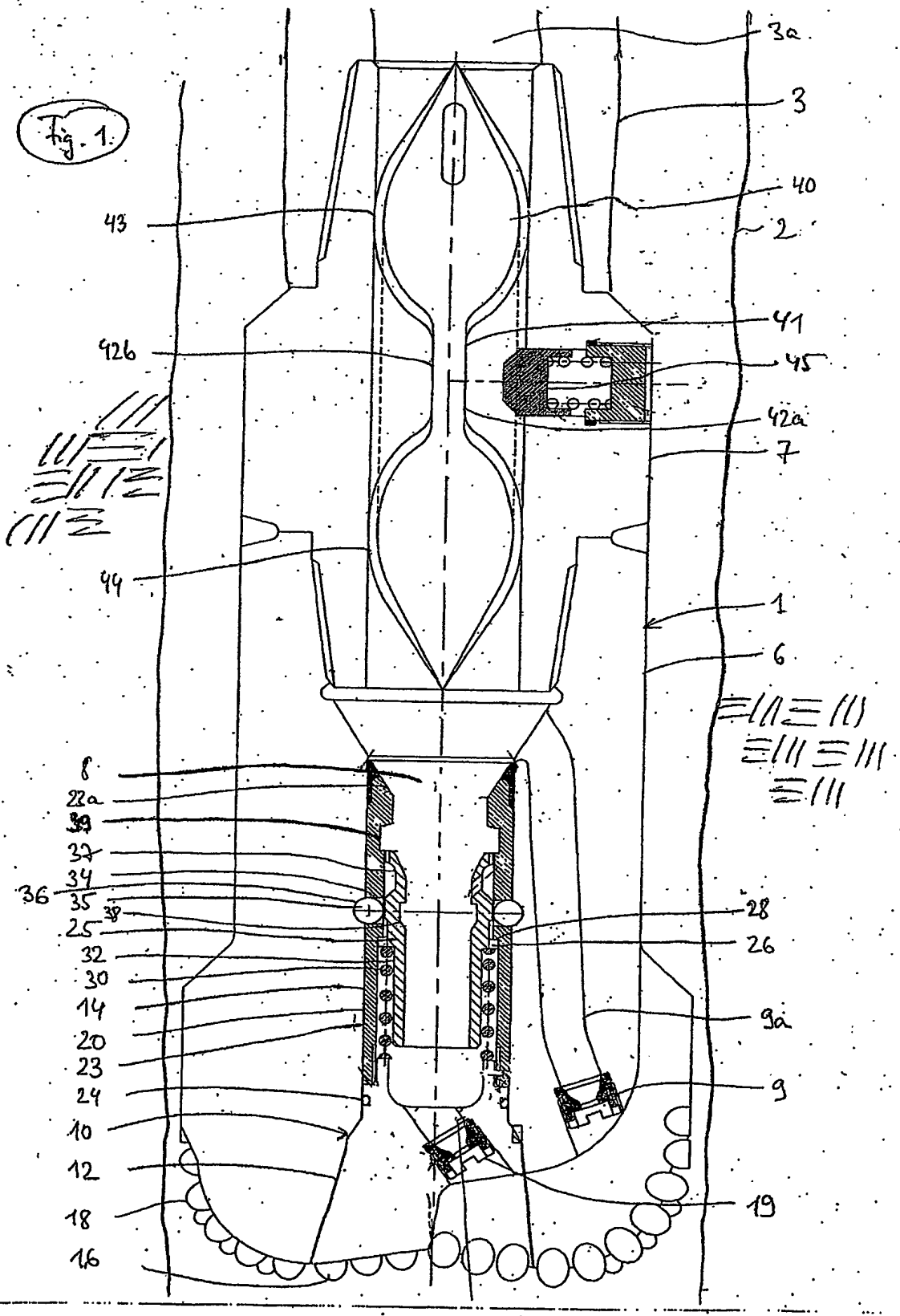
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Fig. 2

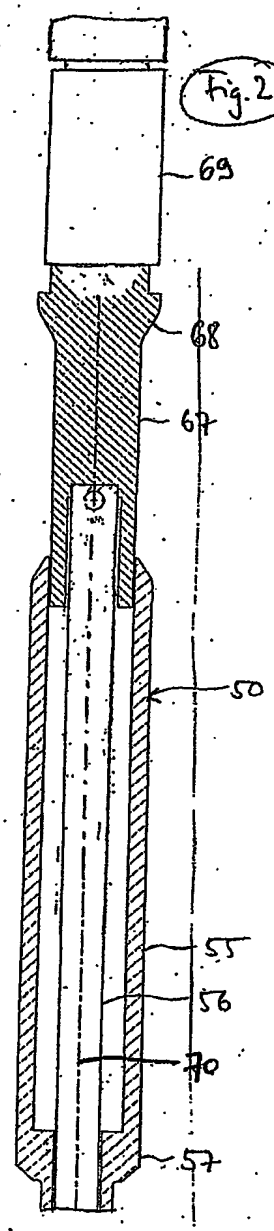


Fig 3

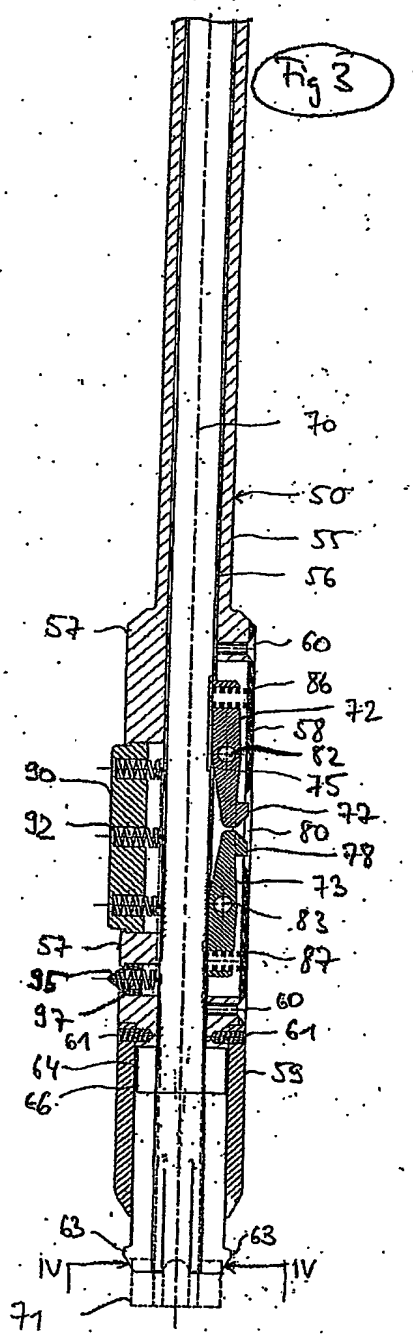
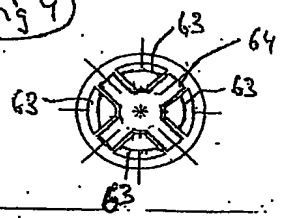


Fig 4



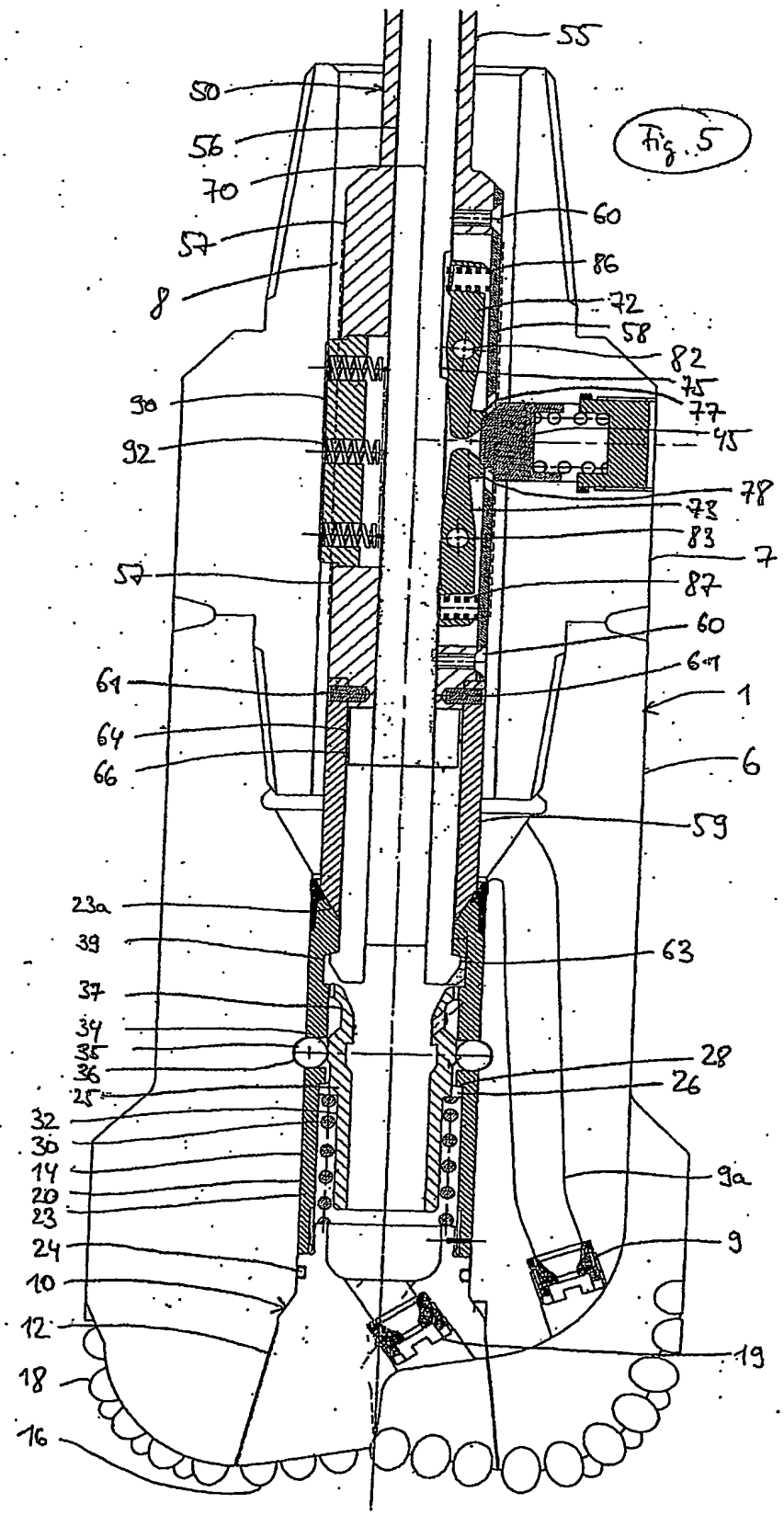

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Fig. 5

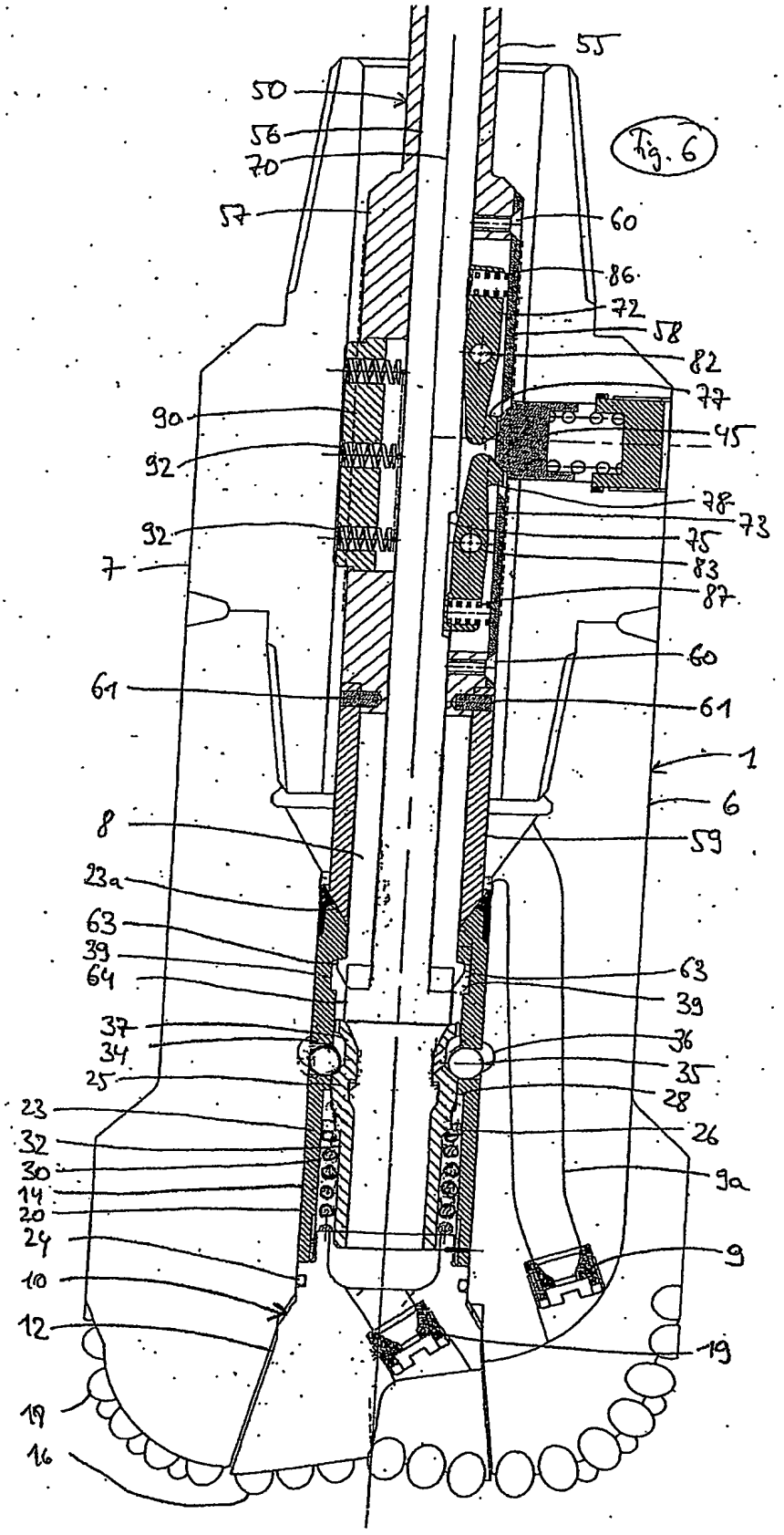
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Fig. 6

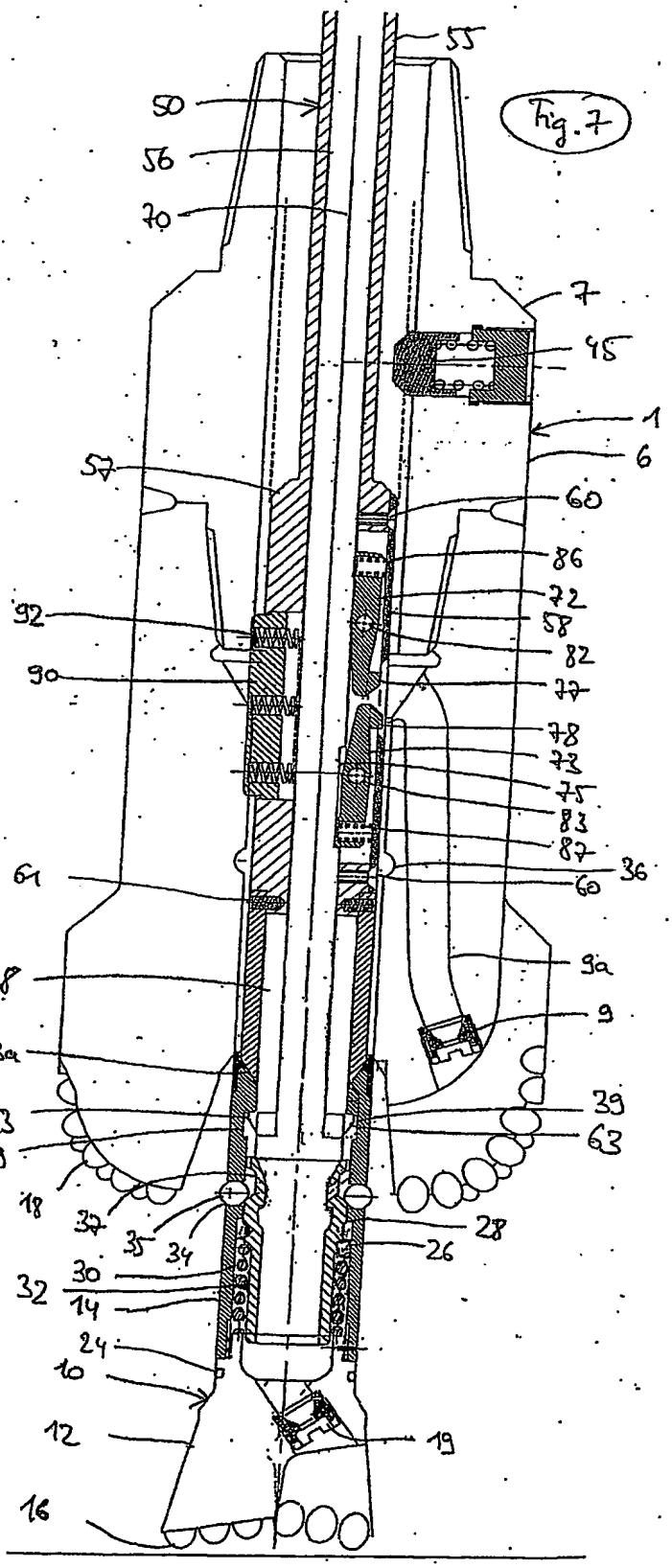
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Fig. 7